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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/663,949	09/16/2003	Roswell J. Ruka	2003P07614US	3856

7590 11/13/2007

Siemens Corporation
Intellectual Property Department
170 Wood Avenue South
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EXAMINER	
WALKER, KEITH D	

ART UNIT	PAPER NUMBER
1795	

MAIL DATE	DELIVERY MODE
11/13/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/663,949	RUKA ET AL.	
	Examiner	Art Unit	
	Keith Walker	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *31 October 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-22* is/are pending in the application.

4a) Of the above claim(s) *19-22* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

On October 31, 2007, the Board of Patent Appeals and Interferences reversed the rejection of the instant claims over the prior art of Tsukuda. Upon further considerations, examination of the instant application is reopened.

Claims 1-22 are pending in the application and claims 19-22 are withdrawn. Claims 1-18 are examined on the merits as discussed below.

Claim Interpretation

The limitation of claim 1, "characterized by accumulated molten particle splats" is a product-by-process limitation. The final product, a fuel electrode, is not in a molten state and so the accumulation of molten particles is a process of reaching the final fuel electrode product that has a microstructure. As such, even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process (MPEP 2113). Applicant discloses on page 3 of the instant specification that the "microstructure generally characterized by accumulated molten particle splats" is attributed to plasma spraying (e.g. atmospheric plasma spraying "APS", vacuum plasma spraying "VPS", plasma arc spraying, flame spraying).

Admitted Prior Art

On page 3 and 4 of the instant specification, applicant discloses that plasma spraying (e.g. atmospheric plasma spraying "APS", vacuum plasma spraying "VPS", plasma arc spraying, flame spraying) is a well known method of fabricating the fuel electrode. This method is useful "to reduce fuel electrode fabrication costs".

Claim Rejections - 35 USC § 102/103

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

1. Claims 1-4, 9-12 & 15-17 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over *Application of Plasma Spraying to Tubular-Type Solid Oxide Fuel Cells Production* (Tsukuda) as evidenced by applicant's known background art.

Tsukuda teaches a tubular solid oxide fuel cell with an air electrode, electrolyte and fuel electrode of ceramic-metal. The ceramic-metal fuel electrode is applied by

plasma spraying and therefore, by applicant's admitted prior art and specification, inherently has a microstructure characterized by accumulated molten particle splats (Abstract, Sec. 1 on Pg. 364). The electrolyte is made of yttria-stabilized zirconia (YSZ) and the fuel electrode comprises nickel and zirconia (Table 1; Pg. 364, second column). An interconnector is used to connect a plurality of solid oxide fuel cells (Figs. 3 & 4).

Regarding claims 9-11, the process of using a nickel graphite mixture to obtain the nickel for the cermet is a product-by-process claim and even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process (MPEP 2113). The final product taught claimed does not include the graphite since it is burned off during the sintering of the electrode, "nickel graphite powder (to provide the nickel, with the graphite burning out" (Page 13 of instant specification). The final fuel electrode taught by Tsukuda comprises nickel and zirconia, the same as the claimed product. Therefore, since the final product taught by Tsukuda is the same as the final product of the instant claims, Tsukuda anticipates the instant claims.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent 5,589,285 (Cable) as evidenced by applicant's Admitted Prior Art.

Cable teaches a solid oxide fuel cell having a cathode of lanthanum manganite, an electrolyte with zirconia and 8 mole% of yttria, and an anode of nickel and zirconia (7:65-8:35, 10:18-20). The amount of nickel used is at least 60% and no more than 85% and the range for zirconia is more than 15% and less than 40% (16:1-20). The interfacial layer between the electrolyte layer and the anode layer is deposited by plasma spraying (8:30-35). This interfacial layer is substantially made from the anode material.

Regarding claims 9-11, the process of using a nickel graphite mixture to obtain the nickel for the cermet is a product-by-process claim and even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process (MPEP 2113). The final product taught claimed does not include the graphite since it is burned off during the sintering of the electrode, "nickel graphite powder (to provide the nickel, with the graphite burning out" (Page 13 of instant specification). The final fuel electrode taught by Cable comprises

nickel and zirconia, the same as the claimed product. Therefore, since the final product taught by Cable is the same as the final product of the instant claims, Cable teaches the same anode composition.

Regarding claims 16-18, a separator connects multiple fuel cells together to form a power generating system (14:44-68). A precursor layer, the interfacial layer, is formed on the fuel side. The layer is preferably 1-50 microns and made from a zirconia composition (8:25-10:18). The solid oxide fuel cell can be tubular in shape (1:55-57).

Cable is silent to the fuel electrode having microstructures characterized by accumulated molten particle splats.

Applicant admitted prior art teaches it is well known in the art to apply the fuel electrode using the plasma spray technique (Pgs. 3 & 4 of instant specification). The plasma spray technique provides the benefit of reducing the fabrication costs.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to use a different method of applying the fuel electrode, as discussed by Cable, with the known plasma spray technique, as admitted by the prior art, to lower the fabrication costs of the fuel cell.

3. Claims 1-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent 5,589,285 (Cable) in view of *Application of Plasma Spraying to Tubular-Type Solid Oxide Fuel Cells Production* (Tsukuda).

The teachings of Cable and Tsukuda as discussed above are incorporated herein.

Cable is silent to the fuel electrode having microstructures characterized by accumulated molten particle splats.

Tsukuda teaches using plasma spraying to apply the nickel-zirconia mixture for the fuel electrode (Abstract, Pgs. 364-365). Plasma spraying provides good performance for the fuel cell by improving the adhesion between each of the components of the fuel cell (Abstract; Pg. 365, second column). Plasma spraying also offers the deposition of a wide range of material compositions, so the mixing ratio of the metal to ceramic can easily be controlled, which in turn controls the coefficient of thermal expansion (Pg. 366, second column). As noted above, plasma spraying inherently gives the microstructure characterized by accumulated molten particle splats.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the fuel electrode application technique of Cable with the plasma spraying technique of Tsukuda to improve the adhesion between components and thereby improve the performance of the fuel cell. Furthermore, the coefficient of thermal expansion can be easily controlled by controlling the mixing ratios of the materials.

4. Claims 5-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Application of Plasma Spraying to Tubular-Type Solid Oxide Fuel Cells Production* (Tsukuda).

The teachings of Tsukuda as discussed above are incorporated herein.

Tsukuda is silent to the percent of nickel and the percent of zirconia present in the fuel electrode composition.

Tsukuda teaches the metallic material for the fuel electrode is a nickel alloy cermet with yttria-stabilized zirconia (YSZ) or a nickel alloy with aluminum oxide (Table 1; Pg. 364, second column). Figure 7 illustrates the relationship of resistivity and the mixing ratio of nickel alloy with aluminum oxide, with the aluminum oxide varying between 20 – 80% (Fig. 7; Pgs. 365-366). This graph shows that varying the metal and ceramic mixture, an optimum resistance for the material can be obtained. Furthermore, the mixing ratio of the metal-ceramic material affects the coefficient of thermal expansion and controlling this ratio allows the compatibility of the fuel cell layers with respect to the coefficient of thermal expansion. While Tsukuda is silent to the composition of the nickel-zirconia mixture, Tsukuda does teach altering the mixing ratio of an equivalent fuel electrode material to improve the conductivity and the matching of the coefficient of thermal expansion.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the nickel-zirconia mixing ratio to optimize the conductivity and coefficient of thermal expansion, since it is held that discovering an optimum value of a result effective variable involves only routine skill in the art (MPEP 2144.05).

5. Claims 5-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Application of Plasma Spraying to Tubular-Type Solid Oxide Fuel Cells Production* (Tsukuda) in view of US Patent 5,035,962 (Jensen).

The teachings of Tsukuda as discussed above are incorporated herein.

Tsukuda is silent to the percent of nickel and the percent of zirconia present in the fuel electrode composition.

Jensen teaches a fuel electrode for an SOFC having a graded composition structure formed by successively depositing layers of nickel-yttria stabilized zirconia mixtures with different compositions (Col. 3, ll. 6-9). Table 1 (Col. 9) gives the compositions of the layers on a volume basis. In order to convert the volume percentages to weight percentages, the following formula was used:

$$\text{Weight\%}_j = \frac{\text{Vol\%}_j(\text{Vol}_j + \text{Vol}_k)\rho_j}{[\text{Vol\%}_j(\text{Vol}_j + \text{Vol}_k)\rho_j] + \text{Vol\%}_k(\text{Vol}_j + \text{Vol}_k)\rho_k} = \frac{\text{Vol\%}_j\rho_j}{[\text{Vol\%}_j\rho_j + \text{Vol\%}_k\rho_k]}$$

The densities used were obtained from www.matweb.com for yttria stabilized zirconia and nickel. The following table lists the weight percents corresponding to the volume percents of Jensen's Table 1.

	Volume percent ZrO_2	**Weight percent ZrO_2**	**Volume percent Ni**	**Weight percent Ni**
Layer 1	70-90	63-87	10-30	13-37
Layer 2	40-60	33-53	40-60	47-67
Layer 3	10-30	7.6-24	70-90	76-92.3

As can be seen from the table Jensen teaches minimums of about 60% Ni and about 15% YSZ (claim 5) and about 70% Ni and about 20% YSZ (claim 6). Jensen also teaches maximums of about 85% Ni and about 50% YSZ (claim 7) and about 80% Ni and about 30% YSZ. The compositions of the individual layers of the multiple layer graded structure approximate a layer in which the composition is continuously graded from being high in zirconia at the electrolyte interface to being high in nickel at the external surface of the anode and meets the simultaneous requirements of adhesion of the yttria stabilized zirconia electrolyte and adequate electrode electrical conductivity.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used the fuel electrode compositions as taught by Jensen in the fuel cell as taught by Tsukuda to meet the simultaneous requirements of adhesion of the yttria stabilized zirconia electrolyte and adequate electrode electrical conductivity.

6. Claims 9-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Application of Plasma Spraying to Tubular-Type Solid Oxide Fuel Cells Production* (Tsukuda) in view of *Processing and Properties of Porous Ni-YSZ Metal/Ceramic Composites* (Clemmer), as evidenced by INCO, Ltd.

The teachings of Tsukuda as discussed above are incorporated herein.

Tsukuda fails to teach that at least a portion of nickel in the fuel electrode is obtained from nickel graphite powder.

Clemmer teaches Ni/yttria-stabilized zirconia fuel cell anodes in which Ni-coated graphite particles (55% Ni content; obtained from INCO, Ltd.: Pg. 233) were used as a starting material. Generally, the anodes created from the Ni-coated graphite particles had a lower coefficient of thermal expansion and higher electrical conductivity for a given Ni loading compared to the anodes made of separate Ni and graphite particles. The hybrid structures had intermediate values of coefficient of thermal expansion and electrical conductivity (Abstract).

Nickel coated graphite particles available from INCO contain either 60 or 75% (www.incosp.com).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used Ni-coated graphite particles, such as those available from INCO, as a starting material for Ni/yttria-stabilized zirconia fuel cell anodes as taught by Clemmer in the fuel cell as taught by Tsukuda in order to achieve lower coefficient of thermal expansion and higher electrical conductivity for a given Ni loading.

7. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Application of Plasma Spraying to Tubular-Type Solid Oxide Fuel Cells Production* (Tsukuda) in view of US Patent 5,589,285 (Cable).

The teachings of Tsukuda as discussed above are incorporated herein; however, the reference is silent to the precursor layer between electrolyte and fuel electrode containing zirconia.

Cable teaches an SOFC with a cathode containing lanthanum manganate (Col. 7, l 66 – Col. 8, l 2), an electrolyte of yttria-stabilized zirconia (Col. 8, ll. 12-14), and an anode containing a nickel powder mixed with zirconia (Col. 10, ll. 18-20). Between the electrolyte and anode, an interfacial layer (applicant's precursor layer) containing sulfur tolerant material is disposed (Col. 3, ll. 1-3); the interfacial layer may contain Y-doped ZrO_2 (Col. 10, ll. 1-4; applicant's zirconia). The thickness of the interfacial layer is generally 1-100 μm, preferably less than 50 μm (Col. 8, ll. 35-37). The interlayer serves to improve electrical contact between the electrolyte and anode and provides an environment in which the species can interact or react because the interlayer keeps sulfur from the fuel from poisoning the anode, particularly Ni/YSZ cermet anodes (Col. 8, ll. 19-34; Col. 6, ll. 55-63; Col. 18, ll. 23-29).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have included the Y-doped zirconia interlayer as taught by Cable between the anode and the electrolyte of the fuel cell as taught by Tsukuda in order to improve electrical contact and provide an environment in which the species can interact or react.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Keith Walker whose telephone number is 571-272-3458. The examiner can normally be reached on Mon. - Fri. 8am - 5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

K. Walker

PATRICK JOSEPH RYAN
SUPERVISORY PATENT EXAMINER

Reopened after a decision of REVERSED by the Board of Patent Appeals and Interferences:

GREGORY MILLS
QUALITY ASSURANCE SPECIALIST
Reopening approved